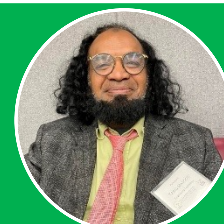
THE UNIVERSITY OF TEXAS AT TYLER

workshop

Power Conversion – Smart Technology Option
ENGR-5317/4317/4350/3301
Lecture No.1



Dr. Tariq Masood, MSE, M.Phil., Ph.D., P.E (UK)
Sr.MIEEE, Sr.MAIChE, MIET, MASCET, MCET

Dr. Tariq Masood

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Dr. Tariq Masood received the **M.Eng, M.Phil., Ph.D** in Electrical Power System Engineering **(smart grid + renewable distributed power generation)** from the university of bath, bath, UK. He also obtained **scientific teaching fellowship**, accredited/sponsored by the **NSF-**national science foundation and **hhmi-** Howard Hughes medical institute at the **United States**. He is a chartered professional engineer registered with royal engineering council, UK and senior member of the IEEE-USA and member of the IET-UK. He is also certified member of the CET international USA and registered member of the ASCET (American society of certified engineers and technicians) USA. He has also delivered more than 100 lectures/workshops on FACTS technology-smart grid **(power conversion, delivery, and renewable energy)** at different universities situated in the USA, UK, Canada, Spain, Italy, India, Qatar and Pakistan. He has also received research scholar award in recognition of his exceptional research work on **"improvement of voltage and power flow control in the gulf cooperative council countries (Qatar, Oman, Bahrain, Kuwait, UAE and Saudi Arabia) through SMART grid by using coordinated FACTS devices"** he is also lean six-sigma green belt certified. Currently, he was serving as a **Vice President Technical Operations** at energy and utilities service new jersey, USA.

He joined the Qatar Energy since 1997 where he served as a technical coordinator operations/advisor Qatar Energy he is/has been on several asset integrity department technical and management committees' member. He is also member of BPTC (best practices technical committee) under the patronage of **H.E: dr. Mohd saleh al-sada** minister of energy and industry Qatar. He has published more than 50 technical research papers in IEEE conference, journal, Honeywell users group and other international conferences and three comprehensive books on micro control at macro level on **SMART GRID** based FACTS technology **ISBN-978-3-659-40995-0 ISBN:978-93-87788-31-2.** He received several awards in recognition of his outstanding performance and dedication to improve Qatar petroleum production operations and control, two Mubarak awards received from H.E minster of energy and industry and three al-hasba awards received from director operations Qatar Energy. He was the secretary for the GCC oil producing companies (**QE-Qatar, PDO-Oman Aramco-Saudi Arabia, KOC-Kuwait, TATWEER-Bahrain, and ADNOC-United Arab Emirates**) production and maintenance technical committee in 2008 and 2011. **Research interest: SMART GRID** control and optimization of process operations of FACTS controllers, financial markets, renewable resources, and control system restructuring, computational intelligence, centralized & decentralized control, large scale optimization and modelling, decision analysis: **he is also serving as an associate editor IEEE access journal (impact factor 3.44)**

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HONORS, RECOGNITION, & OUTSTANDING ACHIEVEMENTS

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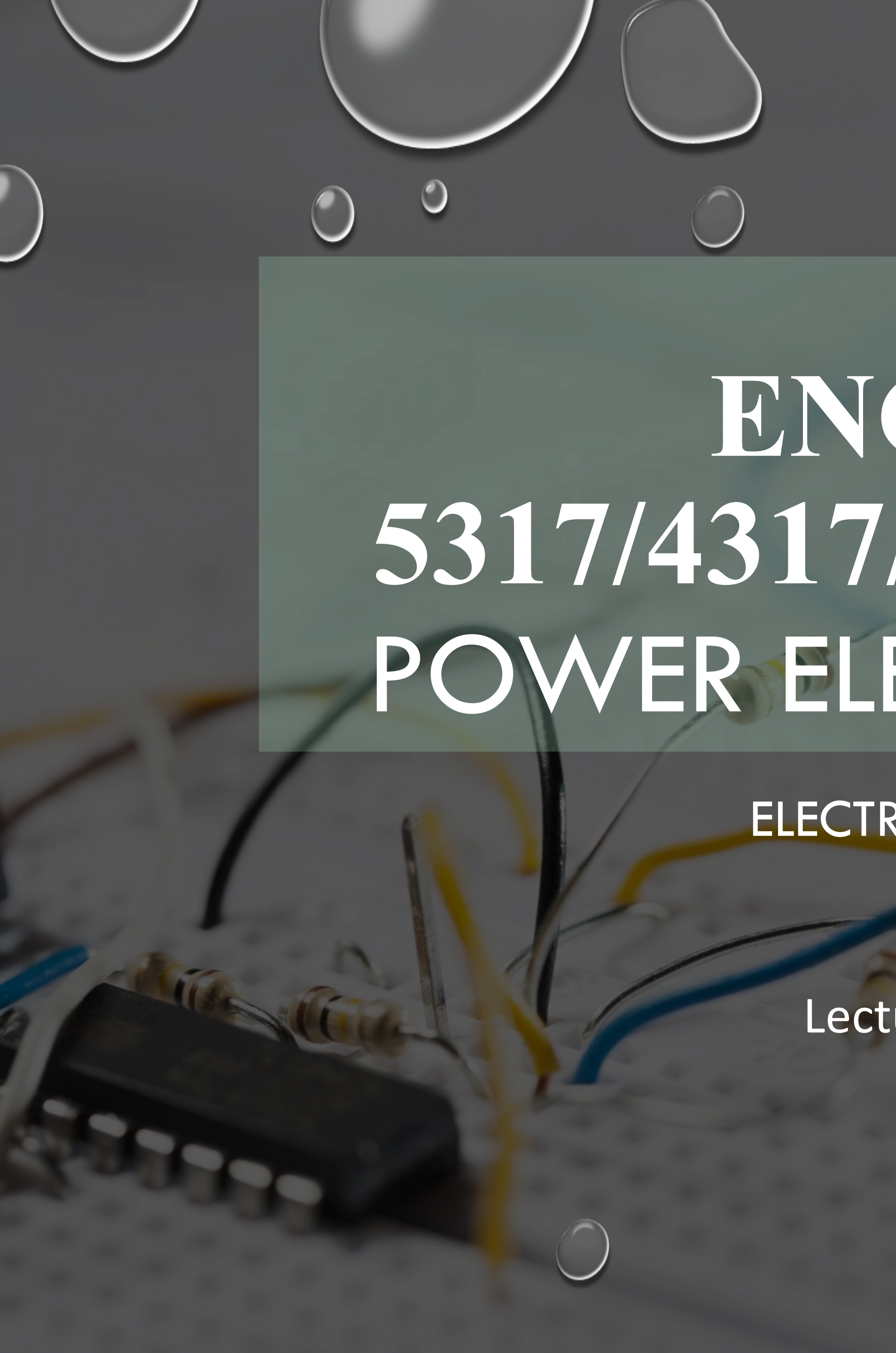
1. **RECEIVED THE M.ENG, M.PHIL., PH.D IN (SMART GRID ELECTRICAL POWER SYSTEM AND RENEWABLE ENERGY)** ENGINEERING FROM THE UNIVERSITY OF BATH, BATH, UK, AND **P.E: PROFESSIONAL ENGINEER REGISTERED** WITH ROYAL ENGINEERING COUNCIL UK
2. **VISITING PROFESSOR** (FULL-TIME) AT OREGON INSTITUTE OF TECHNOLOGY, OREGON, USA.
3. **ADJUNCT PROFESSOR** AT UNIVERSITY OF TEXAS, TYLER TEXAS, USA
4. **VISITING MORE THAN** 30 UNIVERSITIES/ INSTITUTIONS INTERNATIONALLY AND DELIVERED >100 WORKSHOPS AND LECTURES ON **SMART GRID AND RENEWABLE ENERGY**
5. **FORMER TECHNICAL** COORDINATOR/ ADVISOR, QATAR PETROLEUM / OGDC PAKISTAN (HIGH LEVEL EXPERT WITH TOTAL 27 YEARS' EXPERIENCE, **(UPSTREAM, MIDSTREAM AND REFINING FACILITIES, RENEWABLE ENERGIES)**
6. **FORMER EXECUTIVE SECRETARY,** GCC TECHNICAL COMMITTEE (PRODUCTION & MAINTENANCE) ARAMCO, PDO, ADNOC, KOC, QE AND BAPCO
7. **MEMBER OF** ADVISORY BOARD AT PETROLEUM DEPARTMENT TEXAS A&M UNIVERSITY QATAR CAMPUS
8. **JUDGE, VETTED** DIFFERENT RESEARCH PROPOSALS AND PAPERS AT TEXAS A&M UNIVERSITY, AND QATAR UNIVERSITY
9. AUTHOR OF **21** "**PRODUCTION BEST PRACTICES" IN PARTICULARLY OIL/GAS INDUSTRIES,** INCLUDING SIX SIGMA LEAN MANAGEMENT.
10. **FORMER VICE PRESIDENT TECHNICAL OPERATION,** ENERGY & UTILITIES SERVICES NEW JERSEY, USA.
11. **RECEIVED SCIENTIFIC TEACHING FELLOWSHIP-2022**, ACCREDITED/SPONSORED BY THE **NSF-** NATIONAL SCIENCE FOUNDATION AND **HHMI-** HOWARD HUGHES MEDICAL INSTITUTE AT THE **UNITED STATES**.
12. FORMER MEMBER OF **RESEARCH REVIEW COMMITTEE** AT QATAR FOUNDATION, DOHA QATAR **(REVIEWED MILLION $$$ RESEARCH PROPOSALS) RECEIVED FROM ALL OVER THE WORLD.**
13. **LED THE GROUP OF** CEO/PRESIDENTS FROM INDUSTRIES & ACADEMICS IN THE STATE OF QATAR TO BRIDGE THE GAP BASED ON INDUSTRY NEEDS.
14. **SENIOR MEMBER: INSTITUTE OF ELECTRICAL & ELECTRONIC ENGINEERS/AMERICAN INSTITUTE OF CHEMICAL ENGINEER**
15. **RECEIVED 15 AWARDS FROM QATAR ENERGY/GCC TECHNICAL COMMITTEE**
16. **RECEIVED TWO AWARDS FROM IEEE PRESIDENT**
17. **ASSOCIATE EDITOR: IEEE ACCESS JOURNAL (MULTIDISCIPLINE TOPICS)**
18. PUBLISHED 57 RESEARCH PAPERS AND THREE BOOKS**: ISBN-978-3-659-40995-0 ISBN:978-93-87788-31-2**



ENGR-5317/4317/4350/3301 POWER ELECTRONICS

ELECTRONICS

Lecture 1

LECTURE OBJECTIVES

In Today's lecture we are going to discuss about

- Course Syllabus
- Assessments and Policies
- Lab topics and working groups
- Introduction to Power Electronics

Course Syllabus

- DESCRIPTION:

Power electronic device characterization. Rectifiers, DC-DC converters and inverters design, modeling, and build

- HOURS/CREDITS (Lecture-Lab-Total): 3-1-4
- PREREQUISITES:

TEXT AND REFERENCE BOOKS

- **PROFESSOR:**
- TARIQ MASOOD
- SOFTWARE RECOMMENDED:
  - LTSPICE AND MATLAB WITH SIMULINK
- REFERENCES:
- MUHAMMED RASHID, "POWER ELECTRONICS DEVICES, CIRCUITS AND ANALYSIS,"4TH EDITION, PEARSON PUBLISHER
- MOHAN ET ALL, "POWER ELECTRONICS CONVERTERS, APPLICATIONS AND DESIGN", 3RD EDITION, WILEY PUBLISHER
- WEBSITE: ON CANVAS

COURSE TOPICS

Introduction, review of power electronics application in industries

Introduction to power switches

DC to DC converters

AC to DC converters: single phase and three phase

DC to AC converters: single phase and three phase

Application examples: UPS, Thyristor Controlled reactors and Static Var compensators

CLASS SCHEDULE

Date	Topic Covered	Assignment	Reading
Week 1	Syllabus, Power Electronics course overview		
	Basic Principles & Concepts, Review of Fundamentals, Introduction to Switches		
Week 2	DC to DC converters – Buck Converter	HW1	CH6
Week 3	DC to DC converters – Boost Converter and Buck Boost Converter	HW 2	CH6
Week 4	AC to DC converters – single- phase uncontrolled rectifiers	Quiz 1	CH4
Week 5	AC to DC converters – single- phase full controlled rectifiers		CH4
Week 6	Mid Term Exam and Three-phase controlled rectifiers		
Week 7	DC to AC converters – single phase and three-phase converters	HW3	CH4
Week 8	Power Switches, UPS, TCRS and SVC	Quiz 2 HW4	CH8
Week 9	Commutation Circuits, Drive Circuits, Snubber Circuits and Heat Sinks		Lecture Notes
Week 10	Final Exam Review		
Week 11	Final Exam		

LAB DETAILS

Lab 1: Introduction to Switches

Lab 2: Buck Converter

Lab 3: Boost Converter

Lab 4: Light Dimmer Circuit

COURSE OBJECTIVES

Upon completion of this course, the student should be able to

- Discuss the fundamentals of power switches and analyse the performance in steady state and dynamic switching conditions
- Analyse the performance of the power converters under various loads
- Design power converters and the analyse their performance using modern simulation
- software
- Design power converters based on system specific characteristics and compare its performance with simulated results

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Homework and Due Dates

Homework	Date of release	Due date for submission
HW1	22 Jan	20 Jan
HW2	29 Jan	5 Feb
HW3	17 Feb	26 Feb
HW4	24 Feb	6 Mar

LAB DETAILS

Date	Topic Covered	Assignment
Week 2	Introduction to Switches	LAB 1
Week 3	Buck Converter	LAB 2
Week 5	Boost Converter	LAB 3
Week 7	Light Dimmer Circuit	LAB 4

ASSESSMENTS AND GRADE

Assignments	Quantities	Points/quantity	Total Points
Homework	3	5	15*
Quizzes	2	5	10
Lab	4	4+7+7+7	25*
Midterm Exam	1	20	20
Final Exam	1	25	25
Class Participation and professionalism	2	5	5
Total			100*

* Extra Credit

Grade	Distribution
A	90 – 100%
B	80 – 89%
C	70-79%
D	60 – 69%
F	<60%

- You must pass the final exam to be awarded the grade calculated using the above distribution. If you do not pass the final exam, you will receive a failing grade for the course.
- A pass in the final exam is 50% of the total score allotted for that component.

V. GRADE DISTRIBUTION

Grade	Percentage
A	89.5-100%
B	79.5-89.4%
C	69.5-79.4% Problem Sets (5) Labs (5) Exams (1)
D	59.5-69.4%
F	≤ 59.4%

Activities	Percentage
Attendance	10%
Homework	10%
Labwork	15%
Quizzes	15%
Midterm Exam	20%
Final Exam	30%

Factors & Phenomena

- Tech major benefits
- major benefits
- Additional benefits

Technology / System	Asynch. Connection	Bottlenecks	Flicker	Harmonics	Interruptions	Long Lines & Cables	Loop flow	Power Oscillators	Reactive Power Fact	Sags& Swells	Unbalanced load	Voltage Instability
DVR				Additional					Additional	major	Additional	
Energy Storage			Additional	Additional	major			Additional		Additional	Additional	
Harmonic filters		Additional		Tech major			Additional		Tech major			
HVDC	Tech major	Tech major				Tech major	Tech major	Tech major				
HVDC Light	Tech major	Tech major	Additional	Additional		Tech major	Tech major	Tech major	Additional	Additional		Additional
Minicap			Tech major			Tech major			Tech major	Additional		
MINICOMP(STATCOM)		major	major	major				Additional	Additional	Additional	major	
PSGuard Wide Area Monitoring		Tech major			Additional	Tech major	Additional	Tech major	Additional			Tech major
Series compensation		Tech major					Tech major	Additional				Additional
Shunt capacitor		Additional					Additional		Tech major			
Shunt reactor								Additional			Additional	Tech major
Static Freq. Converter		major	Additional	Additional				Additional	major		major	major
SVC		Tech major						Tech major		Additional		Tech major
SVC for Industry			Tech major						Tech major	Additional	Tech major	
STATCOM		Tech major	Tech major					Additional	Additional	Additional	Tech major	Tech major
SVR								Additional		major	Additional	
TCSC		Tech major					Tech major	Tech major				Additional

POWER SYSTEM CHALLENGES/ FACTORS

- Asynchronous connection
- Bottlenecks
- Flickering
- Harmonics
- Interruptions
- Long lines
- Underground cables
- Loop flow
- Power Oscillations
- Reactive Power Factor
- SAG and Swell
- Unbalanced load
- Voltage instability

CLASS POLICIES

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Class instruction

- All lectures will be delivered in-person. Attendance policy is enforced for all lectures. All lectures will be recorded. If you cannot attend the lecture, you have to inform and listen to the recorded lecture before coming to next lecture.
- As a student you are solely responsible for all assigned material. To understand concepts and grasp principles will require your use of personal time. Typically, you should plan to spend a minimum of two hours of reading, studying, homework, etc., for every hour in class. You may be examined on any or all the assigned material. I will present material relative to all objectives for that lesson. You are responsible for all assigned material pertaining to each objective. You are also responsible for information from prerequisite. Refer to the Learning Techniques document for tips on developing good study habits.

CLASS POLICIES

- **<u>QUIZZES, MIDTERM AND FINAL EXAMINATION</u>**

- QUIZZES AND EXAMS ARE GIVEN AS SHOWN IN TABLE 1. NO MAKE-UPS WILL BE GIVEN EXCEPT FOR ADVANCE NOTICE GIVEN

- THE MIDTERM AND FINAL EXAMS ARE CONDUCTED ONLINE IN IN-PERSON/LOCKDOWN RESPONDS BROWSER. ALL QUIZZES AND EXAMS ARE CLOSED BOOK AND CLOSED NOTES.

- THIS ADDITIONAL WORK SHEET SHOULD BE UPLOADED IN QUIZ PAGE. NO FORMULA SHEETS ARE ALLOWED. FOR QUESTIONS REQUIRING CALCULATIONS, YOU MUST SHOW ALL WORK NEEDED TO REACH A SOLUTION ON THE ANSWER SHEET. THE MAXIMUM CREDIT FOR A CORRECT ANSWER WHERE NO WORK IS SHOWN WILL BE 50% OF THE ALLOTTED CREDIT FOR THAT RESPONSE.

- QUESTIONS WILL CONSIST OF MULTIPLE CHOICE (PE STYLE), SHORT ANSWER, AND QUANTITATIVE QUESTIONS BASED ON THE OBJECTIVES OF THE COURSE. THE FINAL EXAMINATION IS CLOSED-BOOK, CLOSED-NOTES, AND NO FORMULA SHEETS ARE ALLOWED. I WILL PROVIDE AIDS THAT ARE REQUIRED TO SOLVE CERTAIN PROBLEMS. ANY FORM OF CHEATING WILL LEAD TO ZERO POINTS.

CLASS POLICIES

CLASS PARTICIPATION AND PROFESSIONALISM

THE INSTRUCTOR EVALUATION PORTION OF YOUR GRADE WILL BE AWARDED BASED ON YOUR PROFESSIONALISM DURING THE COURSE. THE FOLLOWING QUALITIES PLAY INTO YOUR PROFESSIONALISM GRADE: TIMELINESS, QUALITY OF WORK CONTENT, QUALITY OF WORK DELIVERY, ATTITUDE TOWARD FEEDBACK, ATTITUDE TOWARD ASSIGNED TASKS, PUNCTUALITY, ATTENDANCE, ACADEMIC INTEGRITY, INTERPERSONAL SKILLS, FOLLOWING POLICIES AND PROCEDURES AND WORK ETHIC. MID-TERM STUDENT EVALUATION IS PART OF THE GRADE AWARDED FOR THIS SECTION.

CLASS POLICIES

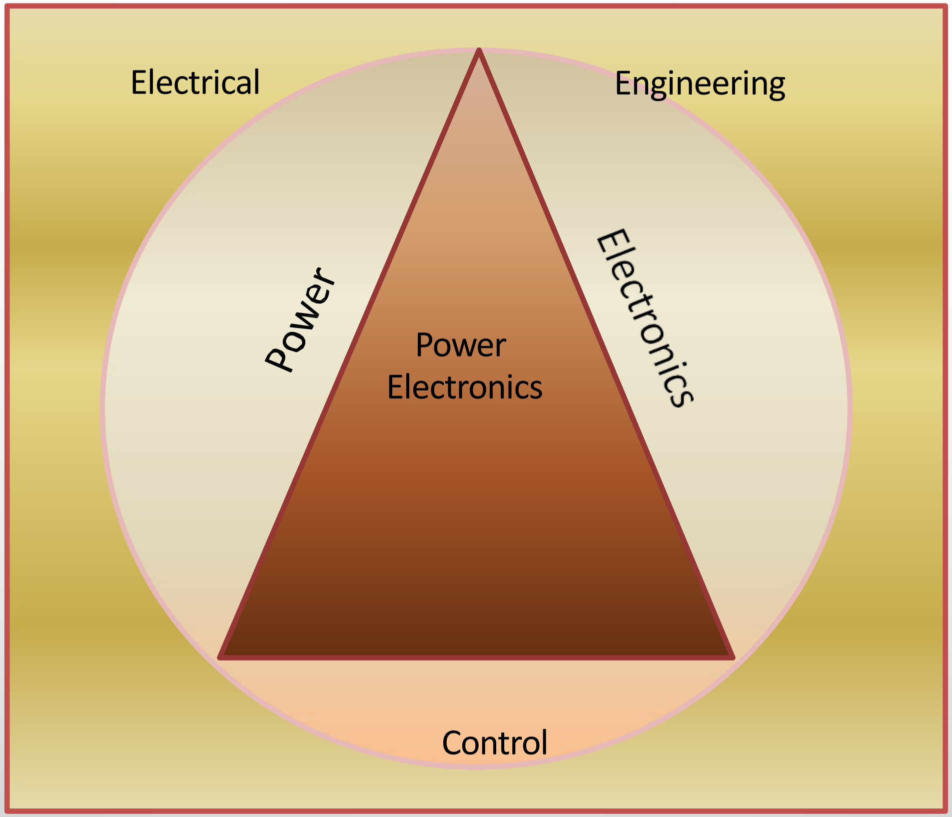
- **ACADEMIC INTEGRITY**

CHEATING ON AN ASSIGNMENT, QUIZ, OR EXAM WILL RESULT IN AN AUTOMATIC ZERO GRADE FOR THAT PIECE OF WORK. CHEATING INCLUDES, BUT IS NOT LIMITED TO, COPYING THE WORK OF OTHERS, USING WORK DONE BY PRIOR STUDENTS, QUOTING/COPYING ANY PUBLISHED MATERIAL WITHOUT ATTRIBUTION, COLLABORATING ON INDIVIDUAL ASSIGNMENTS, USING INSTRUCTOR RESOURCES, ACCESSING INSTRUCTOR SOLUTION MANUALS, ETC. PLEASE REFER TO OREGON TECH STUDENT INTEGRITY POLICY AVAILABLE ON THE OREGON TECH WEBSITE.

INTRODUCTION TO POWER ELECTRONICS

- According to an article by ABB, about 60% of the world's power needs are met by electrical energy.
- That number is quickly rising as the trend towards renewable energy sources increases.
- Without power electronics, this energy cannot be harnessed and delivered efficiently and energy from renewable sources, such as solar and wind, could not be fed into the electricity grid.

WHAT IS POWER ELECTRONICS?



APPLICATION OF POWER ELECTRONICS

Power Electronics

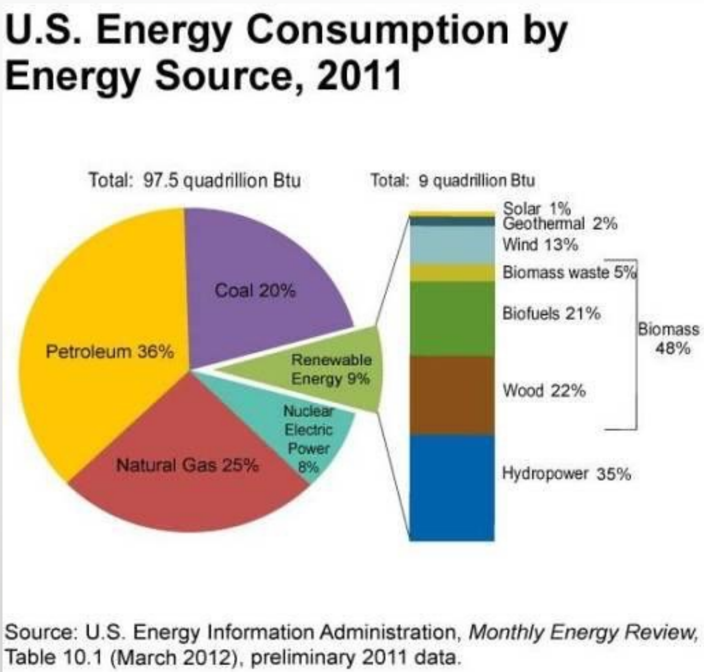
Power Engineering

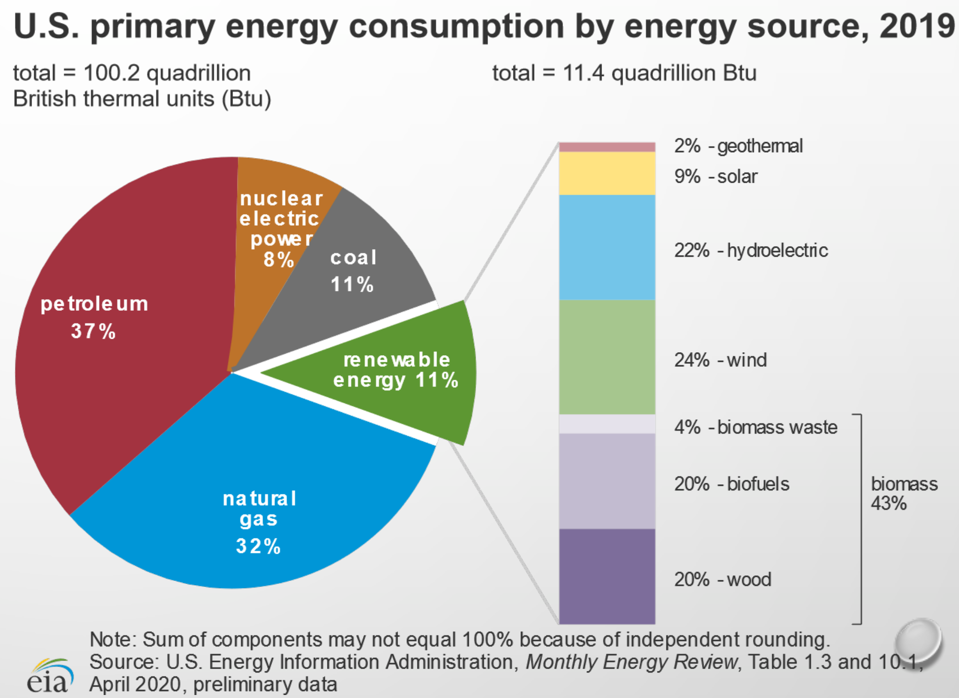
(generation, transmission, distribution and Utilization of electric energy at high efficiency)

Electronics

(distortion less Production, transmission and reception of data and signals at very low power level without much Consideration to the efficiency)

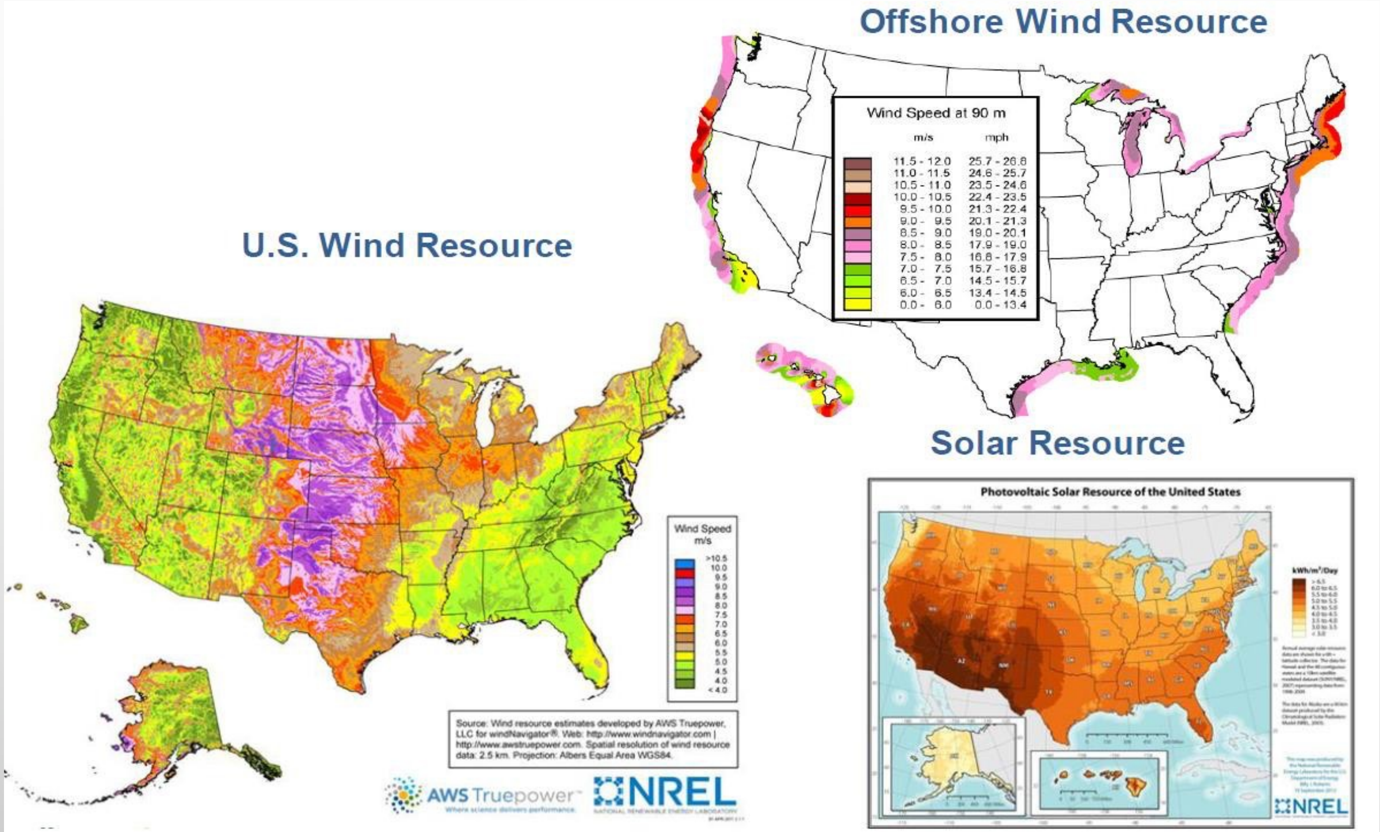
US ENERGY RESOURCES



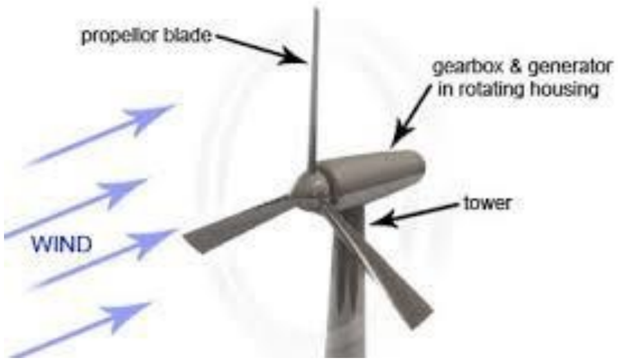


Source: International Energy Agency
GEOTHERMAL
BIOMASS
SOLAR
HYDROELECTRIC
WIND

RENEWABLE ENERGY RESOURCES – SOLAR AND WIND

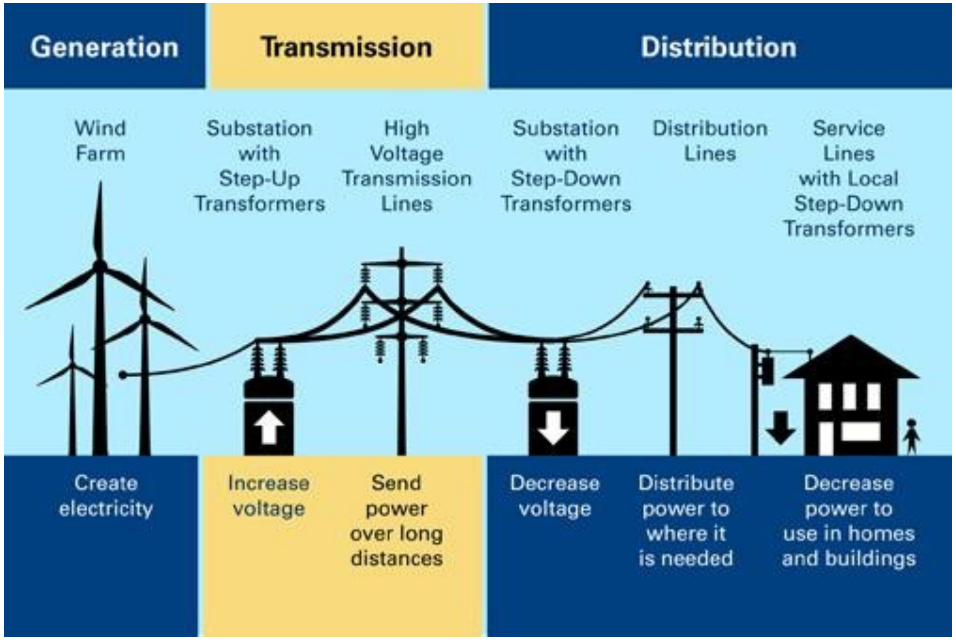


WIND ENERGY SYSTEM (ON SHORE)



WIND ENERGY TRANSMISSION SYSTEM

[https://www.energy.gov/eere/wind/animation-how-wind- turbine-works](https://www.energy.gov/eere/wind/animation-how-wind-turbine-works)



CAREER IN WIND ENERGY SYSTEM

- https://www.energy.gov/eere/wind/animation-how-wind-turbine-works

SOLAR ENERGY

Photo from SunPower Corp
NREL 23816

PV Plant (5~50 MW)

Rooftop PV (1~30 kW)

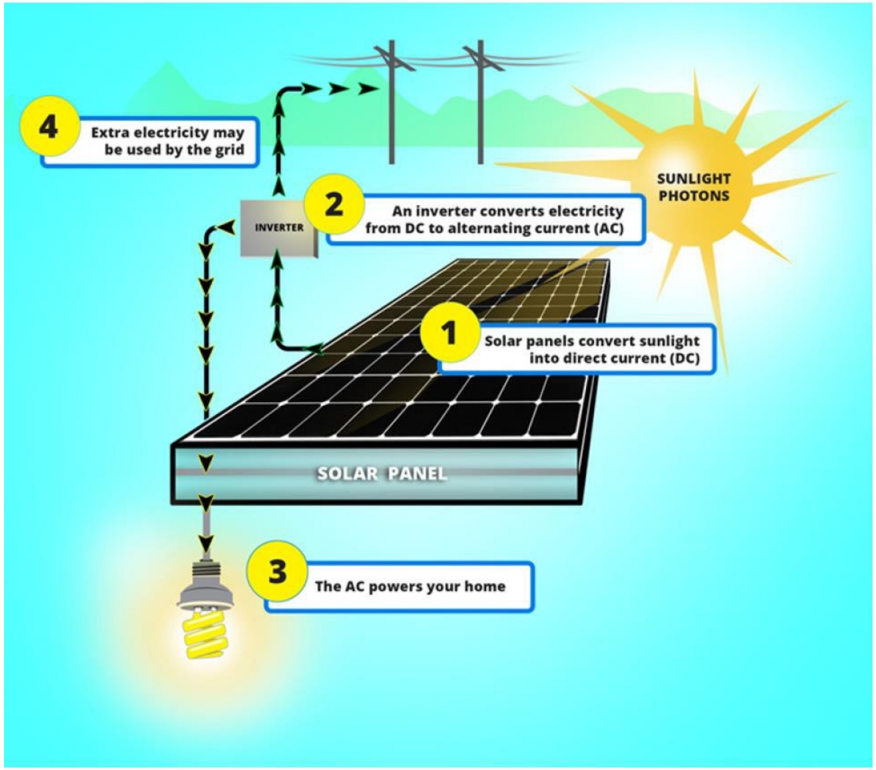
Photo by Dennis Schroeder, NREL 22192

Photo from DOE/FEMP, NREL 27638

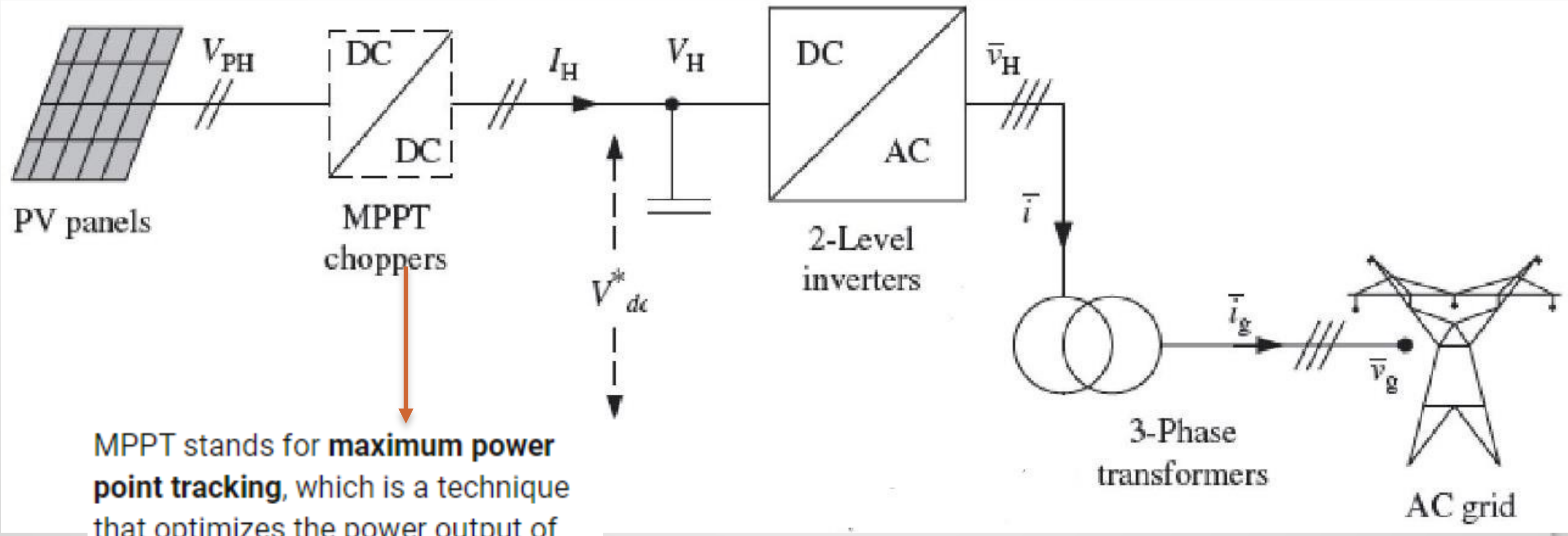
Mobile 9-kW PV System

Courtesy : IEEE Power and Energy Society

Power Electronics in Solar Energy system

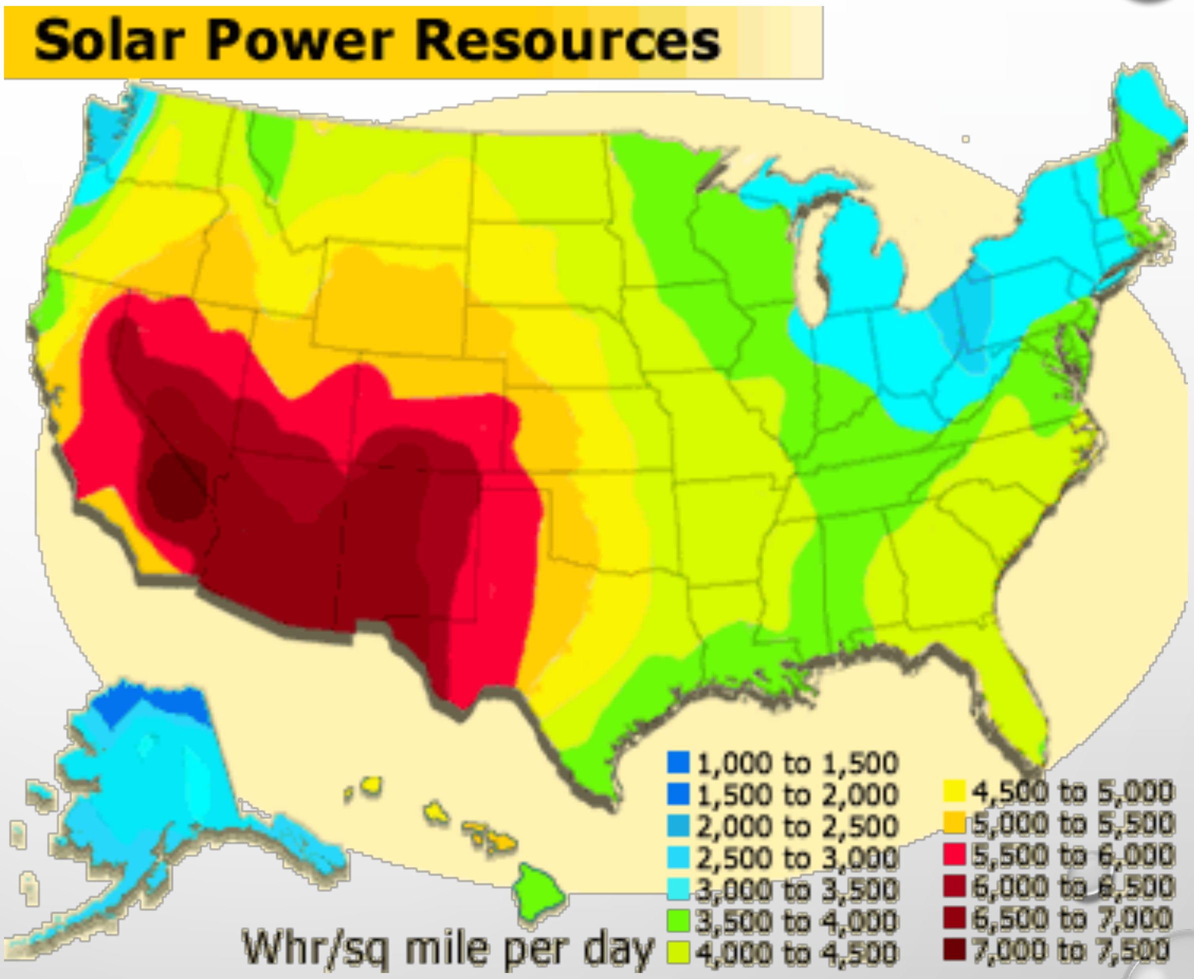


POWER CONVERTERS IN SOLAR SYSTEM



MPPT stands for **maximum power point tracking**, which is a technique that optimizes the power output of the solar panels by constantly adjusting the voltage and current to match the changing conditions of the solar irradiance and temperature.

CAREER IN SOLAR ENERGY SYSTEMS



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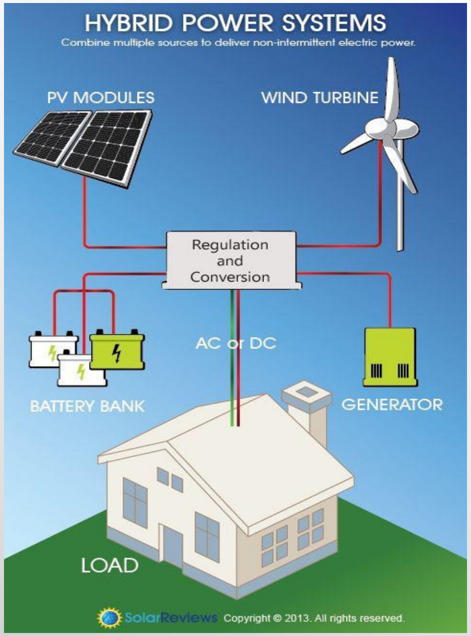
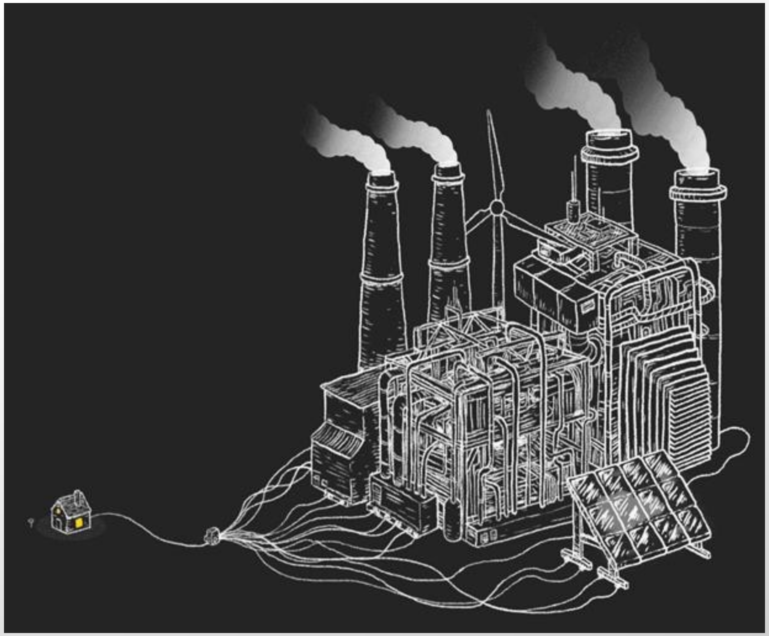
HYBRID ENERGY SYSTEM- SOLAR AND WIND



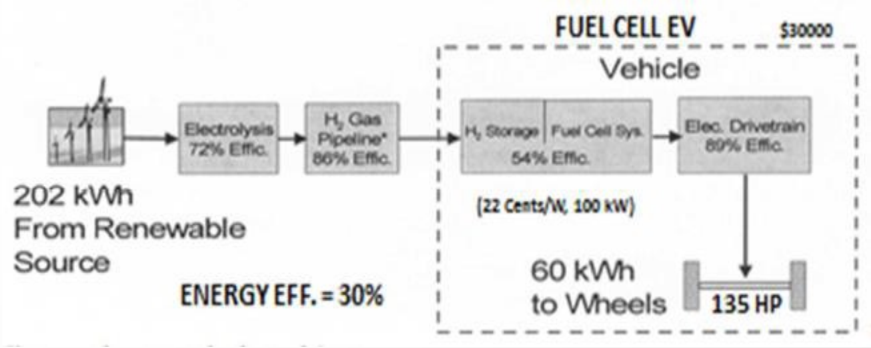


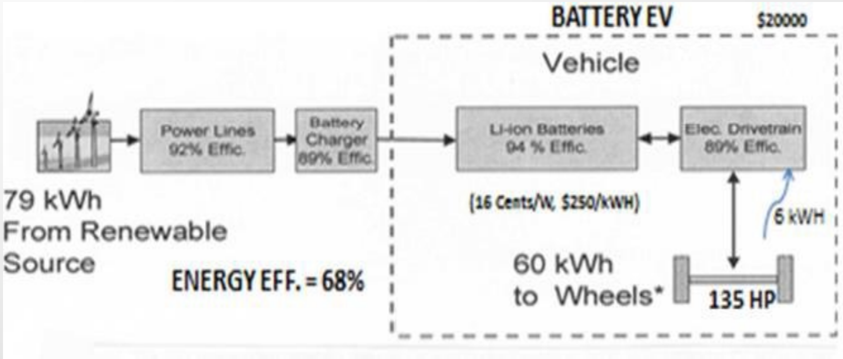
POWER ELECTRONICS IN EVERYDAY LIFE

- EVERYTHING FROM POWER STEERING IN YOUR CAR, BATTERY CHARGERS, CELL PHONES, AND MICROWAVES UTILIZE POWER ELECTRONICS. THE USE OF THIS TECHNOLOGY CAN INCREASE PRODUCTIVITY AND DECREASE COSTS FOR THE MANUFACTURER AND THE CONSUMER.
- POWER ELECTRONICS ALSO ALLOW FOR THE VARIANCE OF ELECTRIC MOTOR DRIVE SPEEDS, REDUCING THE AMOUNT OF ENERGY CONSUMED BY MAKING PROCESSES MORE EFFICIENT. WITHOUT THIS TECHNOLOGY ELECTRIC MOTORS WOULD ALWAYS RUN AT FULL SPEED CONSUMING MORE ENERGY THAN NECESSARY.

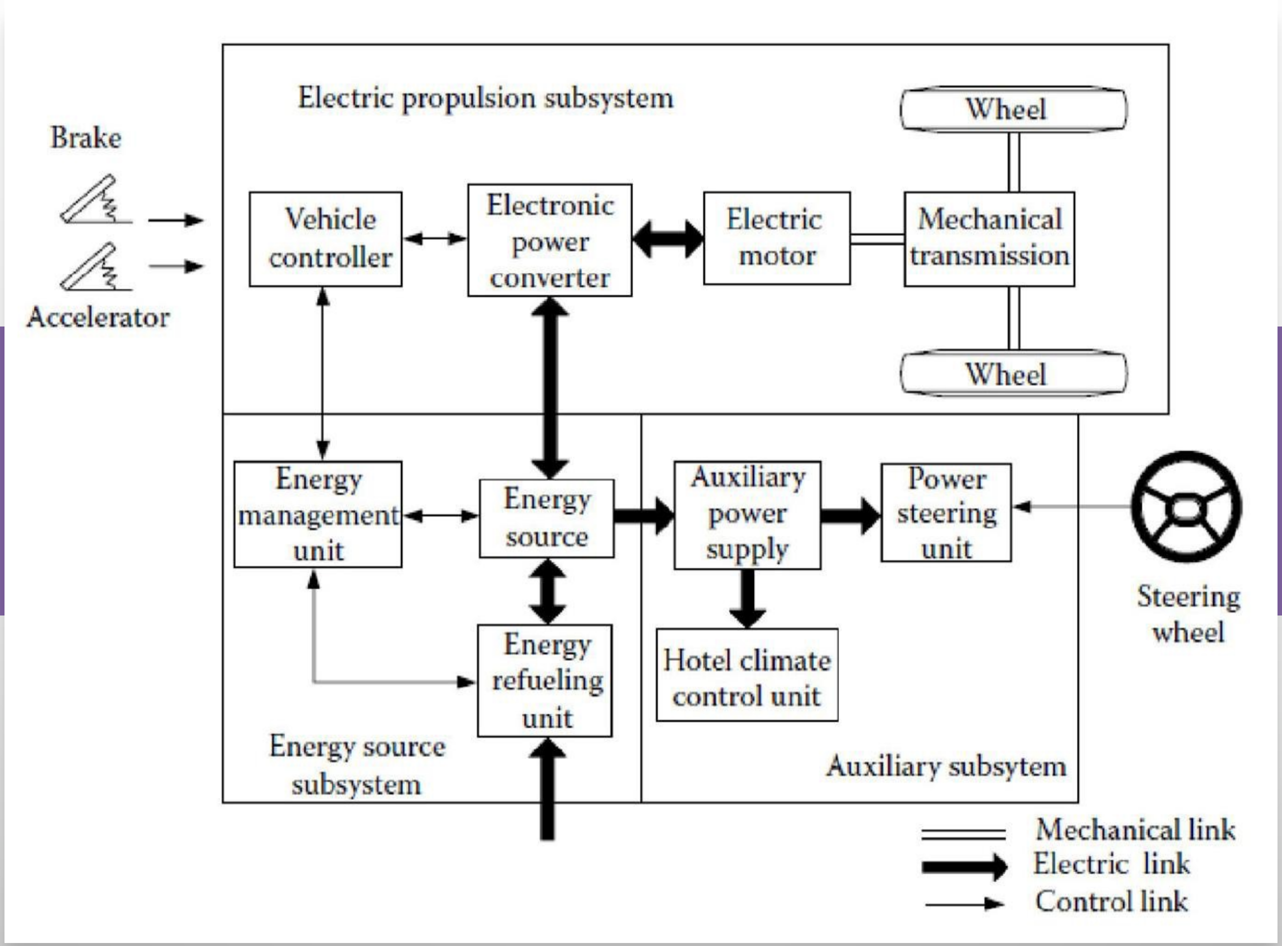
Power Electronics for EV

Energy saving by Battery and Fuel Cell

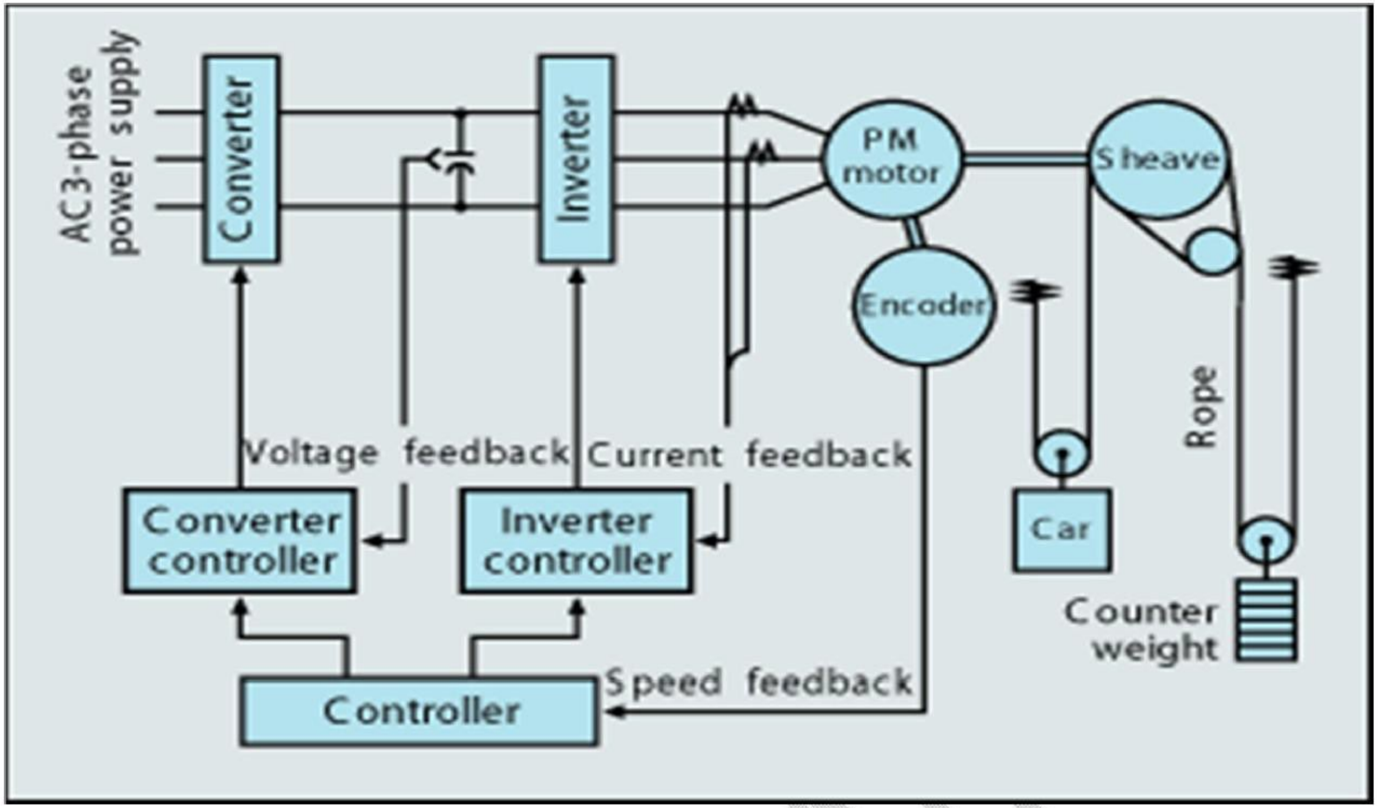




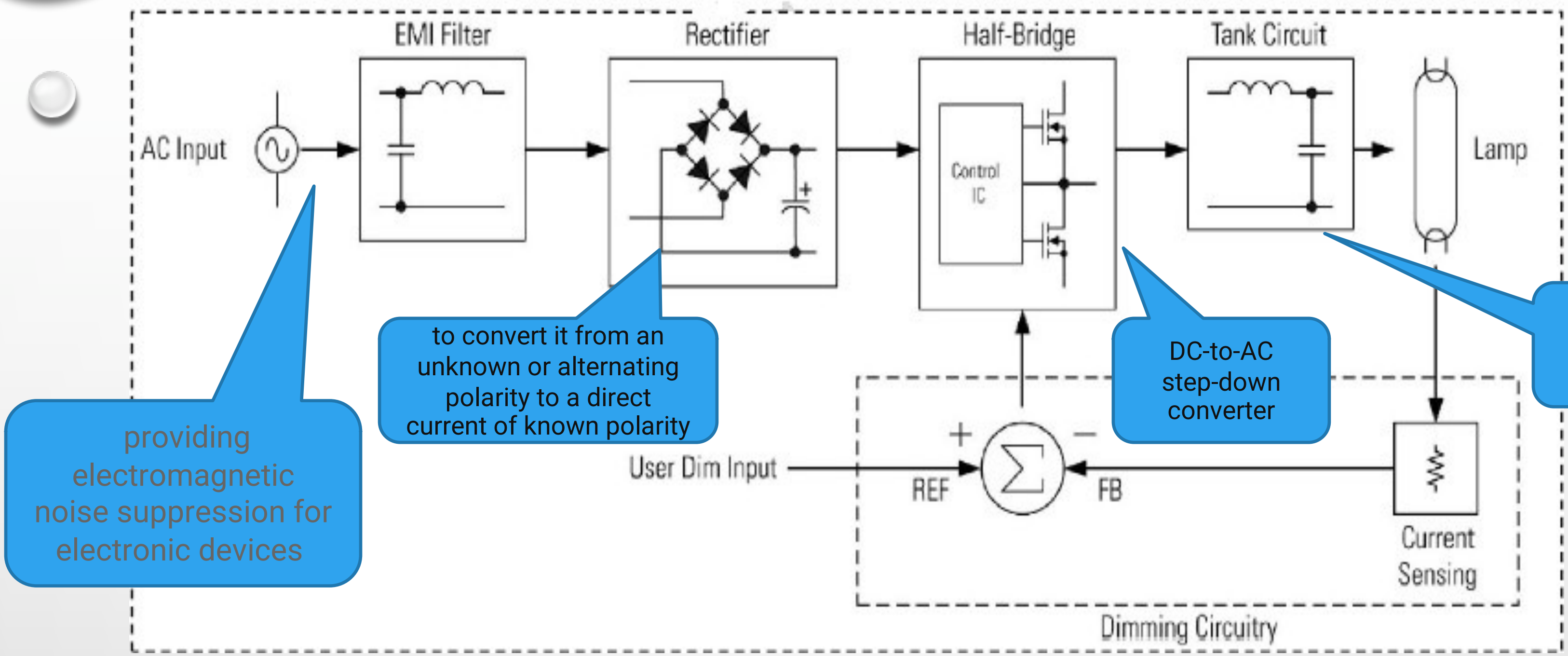
POWER CONVERTERS IN ELECTRIC VEHICLE

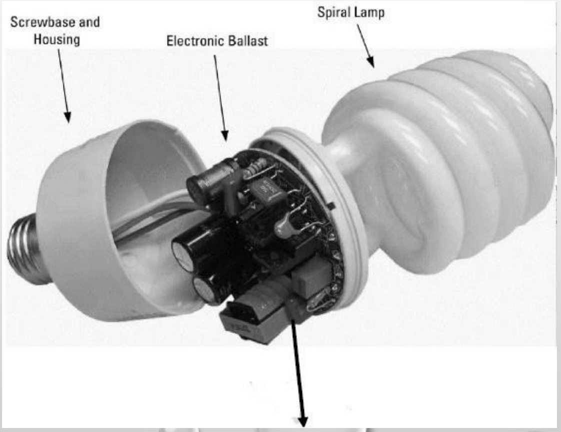


POWER CONVERTERS IN ELECTRIC ELEVATORS

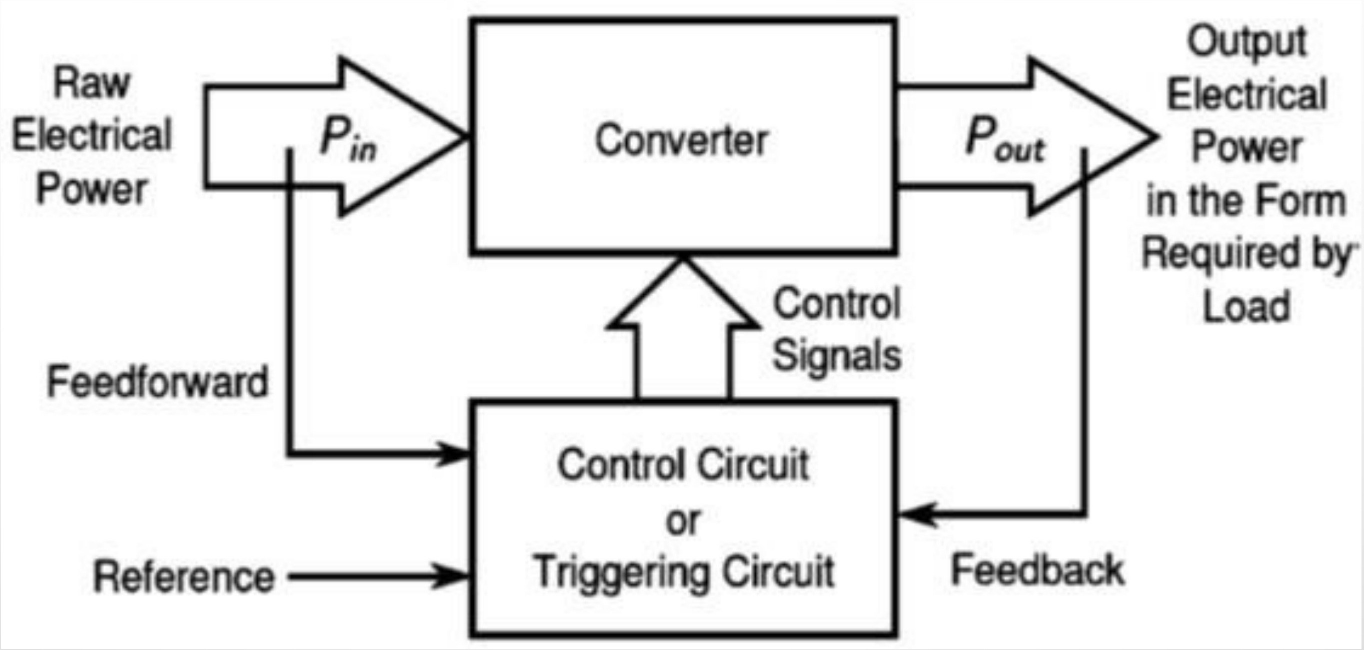


POWER CONVERTERS IN ELECTRONIC LIGHTING



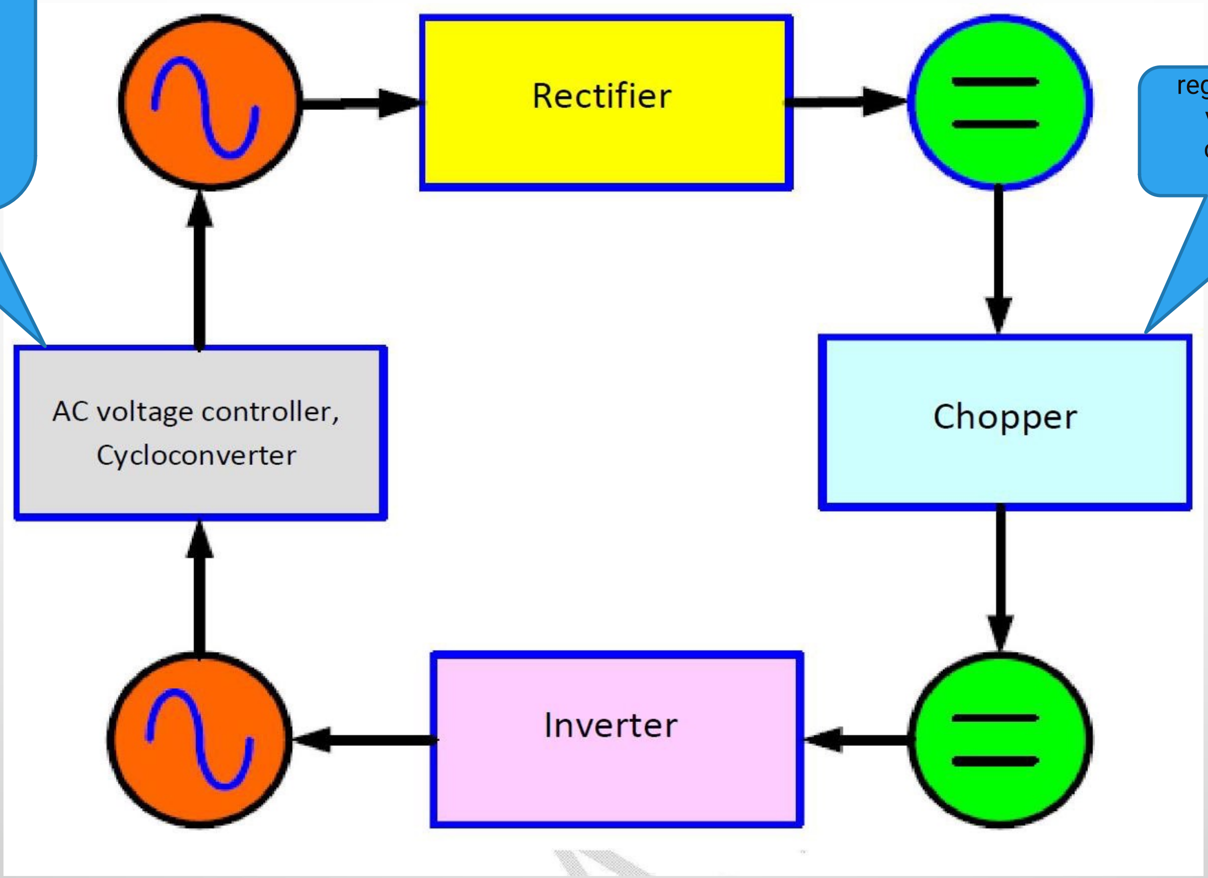


POWER ELECTRONICS IS A POWER PROCESSOR



POWER CONVERTERS

cycloconverter is a **single-stage frequency changer** that converts alternative voltage from one fixed frequency to another frequency without the help of an intermediate dc link



regulate the output current/ voltage and reduce the current drawn from the power source

Advantages of Power electronic Converters

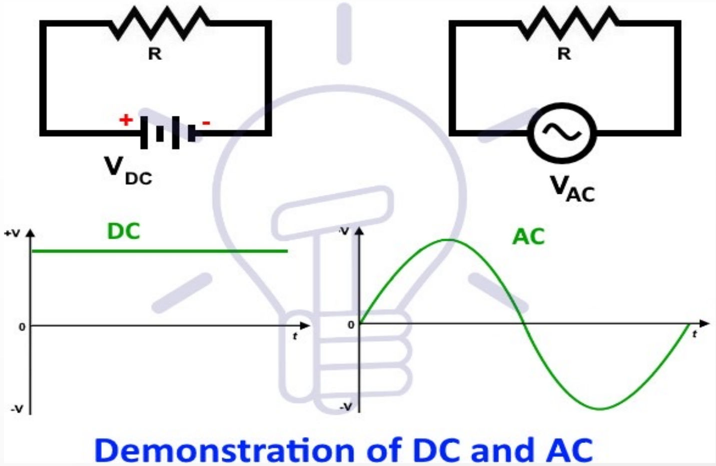
- HIGH EFFICIENCY DUE TO LOW LOSS IN POWER SEMICONDUCTOR DEVICES
- High reliability of power electronic converter systems
- Long life and less maintenance due to the absence of any moving parts
- Fast dynamic response of power electronics systems as compared to electromechanical converter systems
- Lower cost of power converter equipment

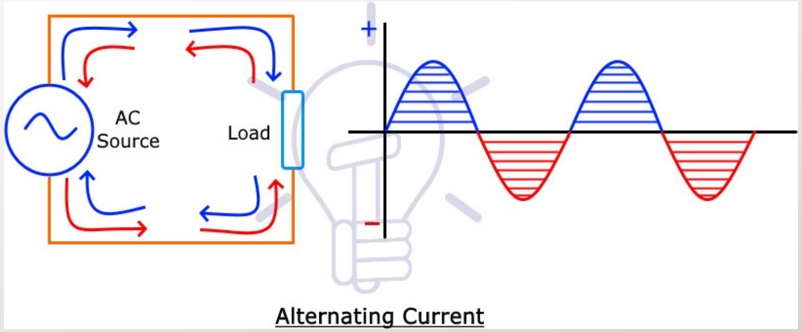
Disadvantages of Power Electronic Converters

- GENERATE HARMONICS IN THE SUPPLY SYSTEMS AS WELL AS IN THE LOAD CIRCUIT
- AC to DC or DC to AC converters operate at a low input power factor under certain operating conditions
- Low overload capacity
- Power regeneration is difficult

REVIEW OF FUNDAMENTALS

AC AND DC?



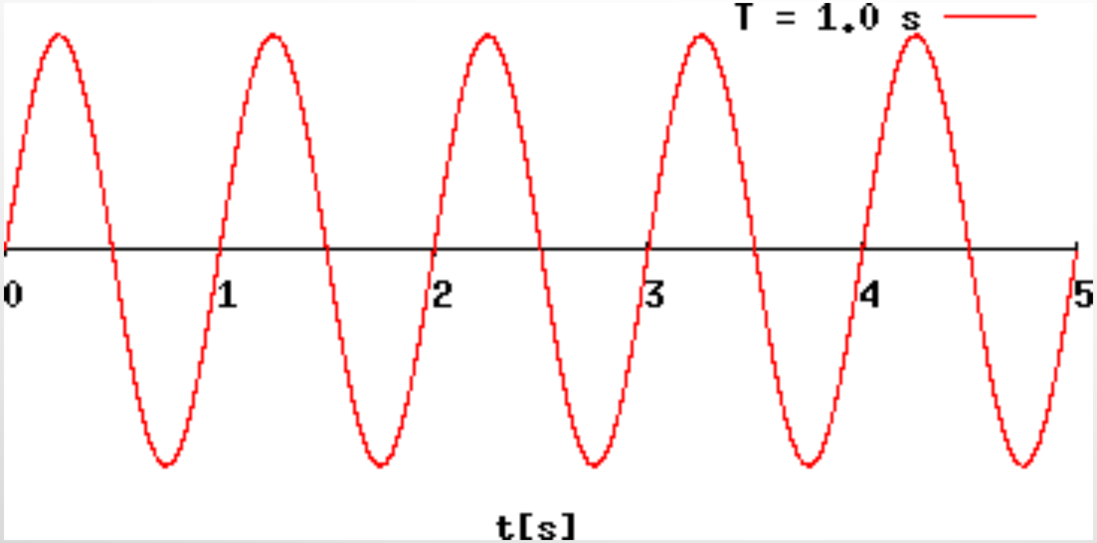


https://www.electricaltechnology.org/2020/05/difference-between-ac-dc-current-voltage.html

FREQUENCY

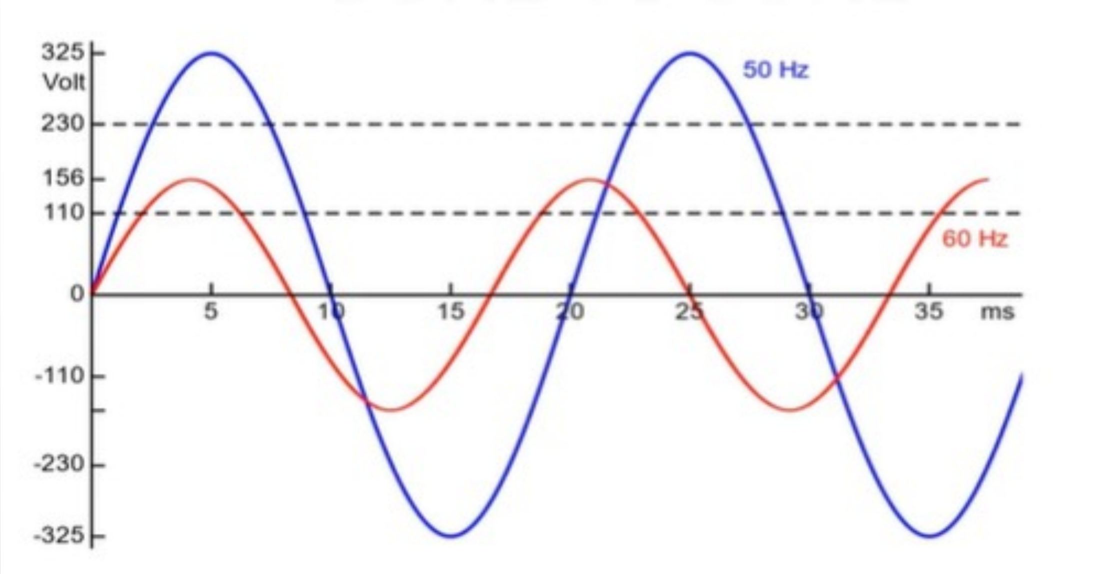
- Period of Oscillation

$$Frequency = \frac{1}{Time}$$



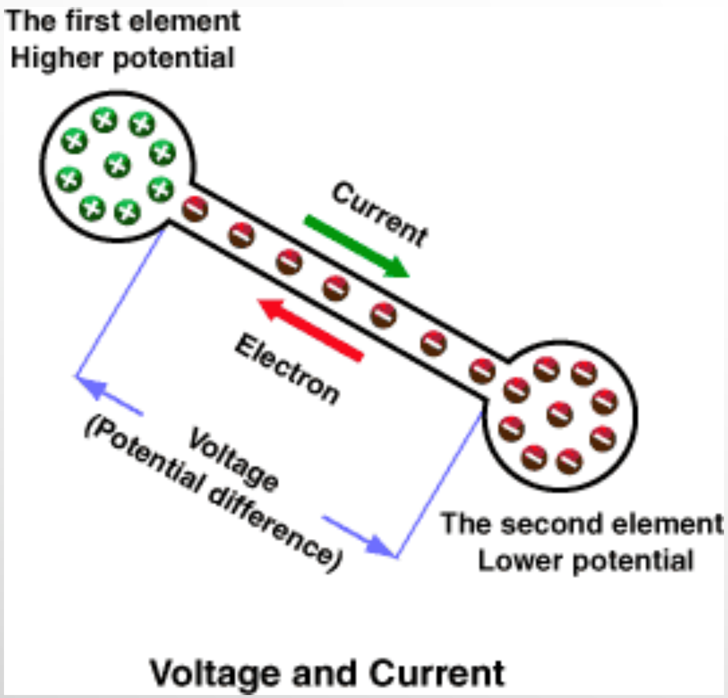
$$f = \frac{1}{t}$$

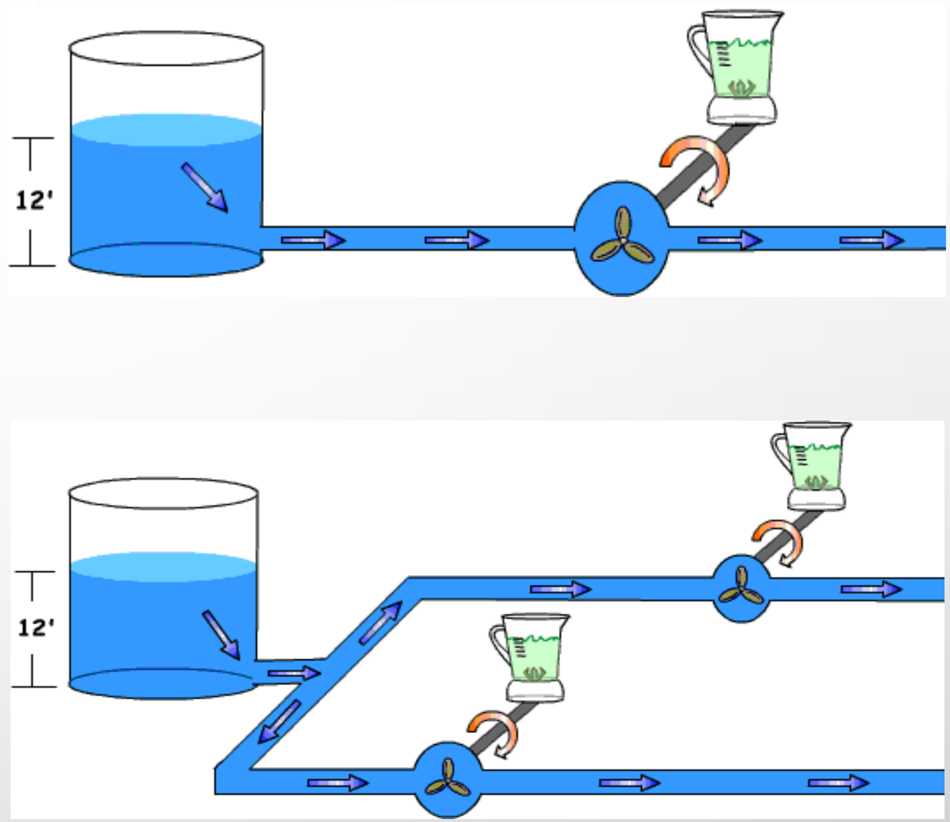
50HZ VS 60HZ



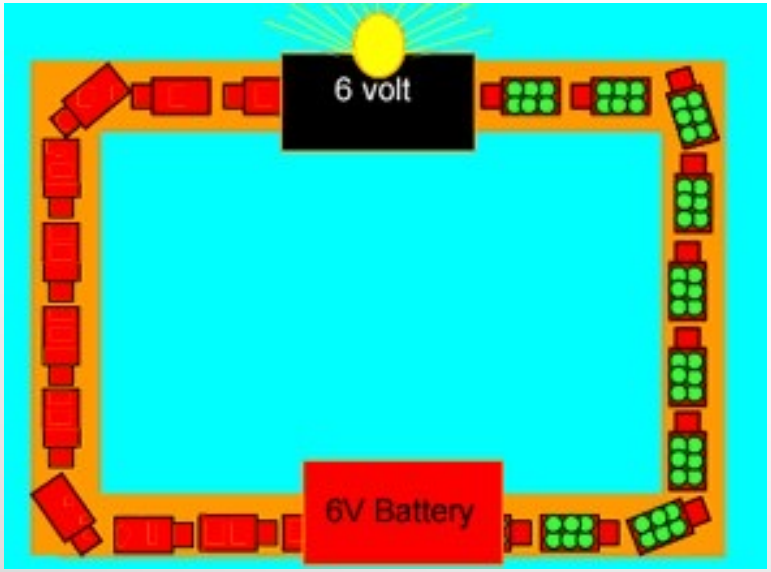
- Courtesy: Wikipedia

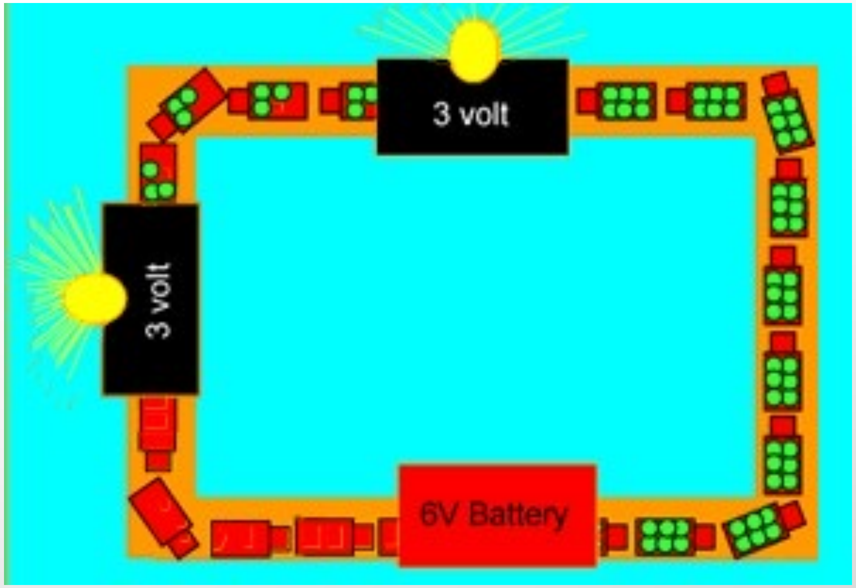
VOLTAGE VS CURRENT





VOLTAGE VS CURRENT





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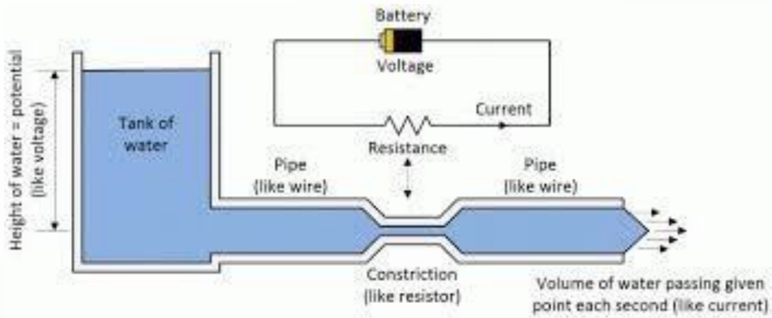
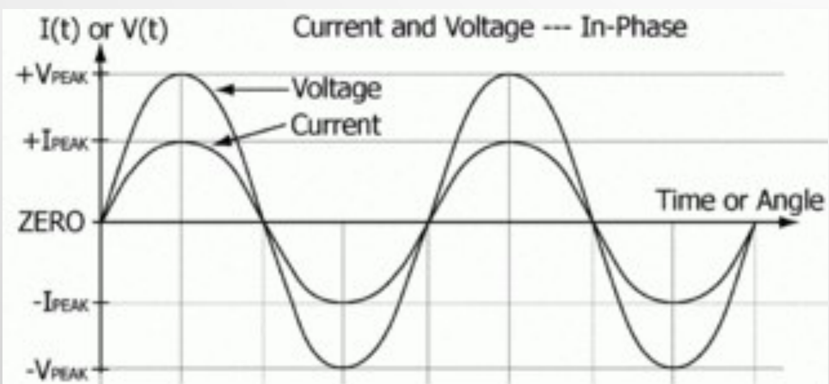
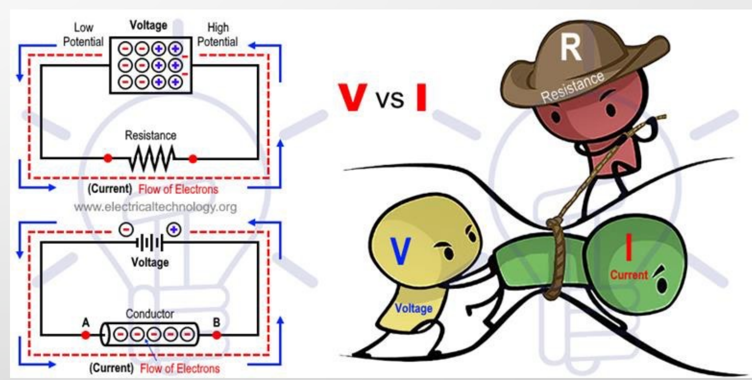
BASIC ELECTRICAL COMPONENTS - RESISTOR



V = I multiplied by R V = IR





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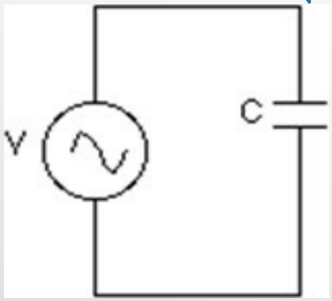
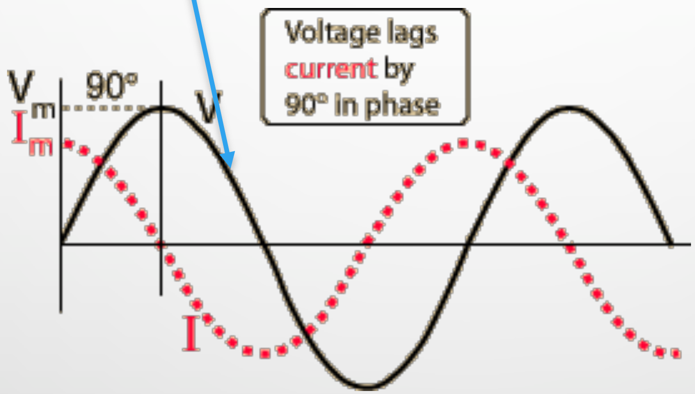
BASIC ELECTRICAL COMPONENTS - CAPACITOR

Capacitor is the Voltage storage device

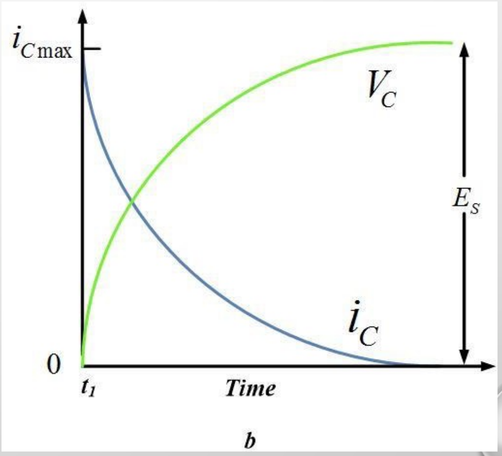


In capacitor current lead the voltage



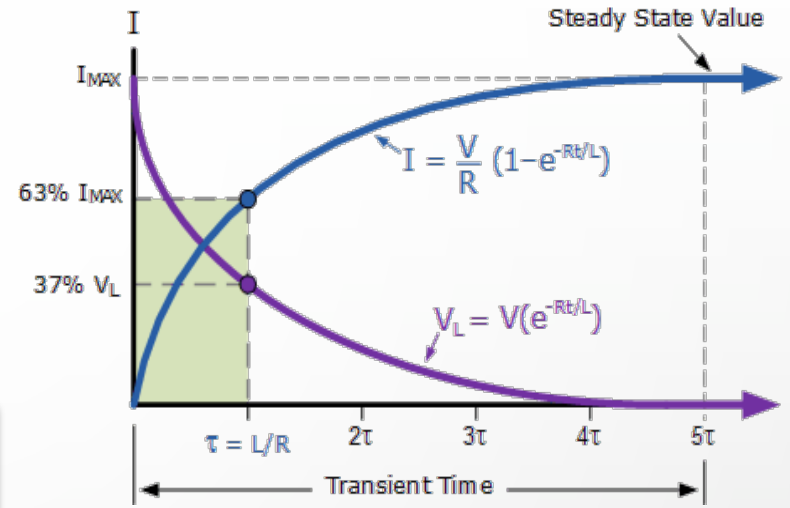
$$i_c(t) = C\frac{dv_c}{dt}$$

$$v_c(t) = \frac{1}{c}\int_o^t i_c(\tau)dt + v_c(0)$$



When capacitor discharging the voltage polarity will be reversed, current will not change its polarity

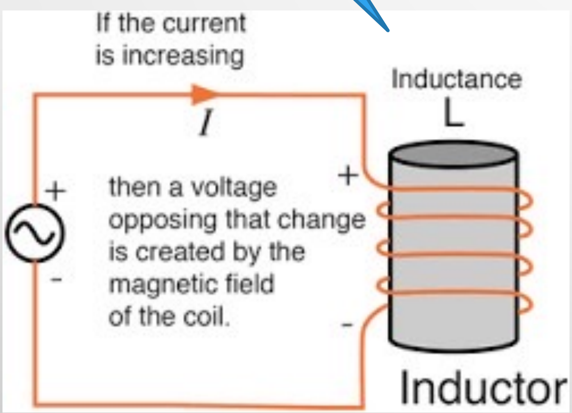
BASIC ELECTRICAL COMPONENTS - INDUCTOR

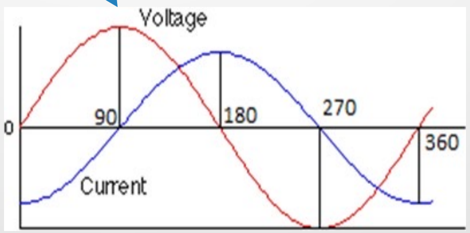


Inductor is the Current storage device

In Inductor voltage lead the current

$$i_L(t) = \frac{V}{R}\left(1 - e^{-\left(\frac{R}{L}\right)t}\right)$$



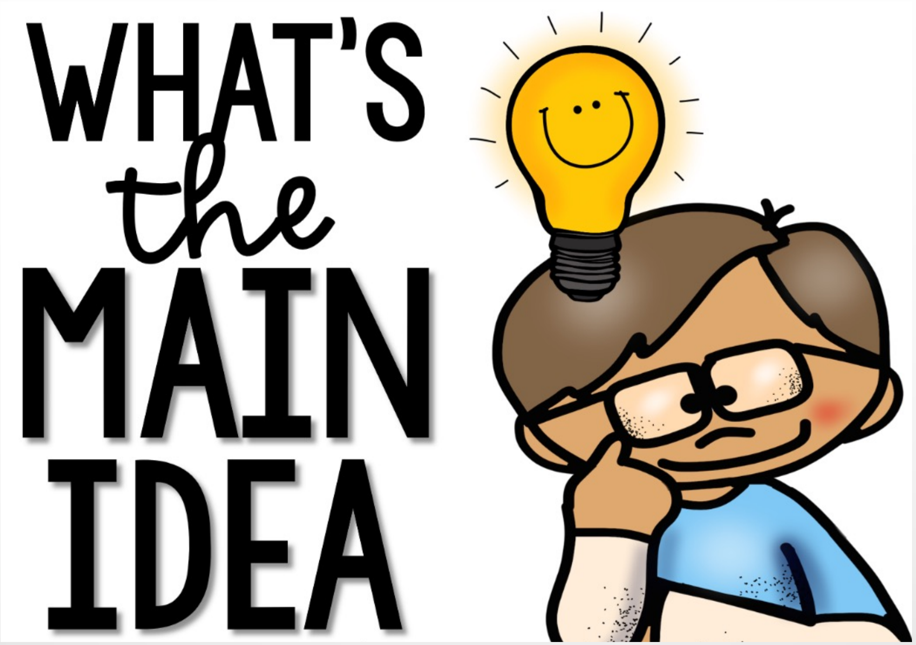


$$v_L(t) = L\frac{di_L}{dt}$$

When Inductor discharging the voltage polarity will be reversed, current will not change its polarity

REFERENCE

- Text Book: Chapter 2


WHAT'S
the
MAIN
IDEA

List of Publications within GCC Countries, Aspen Tech HYSYS, Honeywell, IEEE Conference and Journal papers

In 2023, Supervise & Support the Students & Published Three Papers as Listed Below

1. Jake Cometto, Maiya Baker, Mohsin AlMufargi, Rayan Saggaf, **Tariq MASOOD** "***STATCOM tailored model's configuration technique to optimize and remove the Bottleneck (constrained transmission paths) in the electrical power grid to prevent any potential blackout***" paper accepted for publication for the IdeaFest Research Conference from June 1-2, 2023 **held at Oregon Institute of Technology, Klamath Falls and Portland, Oregon, US**
2. Alessandro Zago, Cameron Berreman, Clinton Lytle, Gabe Bennet, **Tariq MASOOD** "***Smart Grid, Technology Option to Resolve Persisting Stalemate of the Power System Operations by Implementing HVDC link for the bulk power delivery in the long transmission lines***" paper accepted for publication for the IdeaFest Research Conference from June 1-2, 2023 **held at Oregon Institute of Technology, Klamath Falls and Portland, Oregon, US**
3. Kyle Gallegos, Ryan Kile, Josiah Rygh, Vitaliy Tveritin, **Tariq MASOOD** "***A Tailored STATCOM Model Control Configuration to Dynamically Address Voltage Instability in Order to Prevent a Potential Blackout of the Electrical Power System***" paper accepted for publication for the IdeaFest Research Conference from June 1-2, 2023 **held at Oregon Institute of Technology, Klamath Falls and Portland, Oregon, US**

In 2023, four papers have been published as Listed Below

4. **Tariq Masood**, Syed Umer Abdi and Muhammad Anus Masood "***Smart Grid Technology Option: Static Var Compensator (SVC): Configuration to support Grid Voltage at steelworks and railway feeder connected to the public grid by addressing Voltage Instability***" paper accepted for publication for the IdeaFest Research Conference from June 1-2, 2023 **held at Oregon Institute of Technology, Klamath Falls and Portland, Oregon, US**
5. **Tariq Masood**, Syed Umer Abdi and Muhammad Anus Masood "***TCSC prototype device design and configuration technique to control and mitigate Loop flow, and Bottlenecks in the Complex Power System Network to Prevent possible major Blackout***" paper accepted for publication for the **IdeaFest Research** Conference from June 1-2, 2023 **held at Oregon Institute of Technology, Klamath Falls and Portland, Oregon, US**
6. **Tariq Masood**, Syed Umer Abdi and Muhammad Anus Masood "Smart Grid Technology Option: Static Var Compensator (SVC): Configuration Technique to address Power Oscillation Damping at Steelworks & Railway Feeder connected to the Public Grid" paper accepted for publication for the East Texas Research Conference from April 20-21, 2023 **held at University of Texas Tyler, Texas, USA**
7. **Tariq Masood**, Syed Umer Abdi and Muhammad Anus Masood "Smart Grid, Technology option to resolve operations and control challenges of Electrical Power System from Generation, Transmission, Distribution up to Consumer levels" paper accepted for publication for the East Texas Research Conference from April 20-21, 2023 **held at University of Texas Tyler, Texas, USA**

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As conclusion the **EERE** requires smart technological Idea and concept and their successful implementation

Thank You for your attention

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